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FARMLAND

WILL THERE BE ENOUGH?



FARMLAND: WILL THERE BE ENOUGH?

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The world, within the past two years, has entered a new era of food scarcity. While this is hardly new or news to much of the less developed world, it strikes hard at Americans who are accustomed to plenty, even surpluses.

Since the 1930's, U.S. agricultural capacity has exceeded demands for agricultural products. Excess capacity was fueled by a combination of rich natural resources and rapid technological advance. We even legislated farm programs to restrict production as surpluses of various commodities drove farm prices and incomes down. Government programs in the 1960's diverted from 39 to 65 million acres from crop use. Since 1972, however, expanding foreign markets and adverse world climatic conditions accelerated food demand. Nearly all of the U.S. diverted acreage was subsequently released for crop use in time for 1974 plantings. In this new period of world food scarcity, Americans are forced to reconsider the potential of their agriculture industry.

Fortunately, the U.S. land resource base appears ample for future domestic needs, at least beyond the year 2000. It also seems likely that U.S. farmers will have adequate land and technology to make sizeable commitments to the export market. But, it may not come easily; how well we do will depend on our chances for higher productivity per acre and our chances for more crop acres. Our record since 1950 sets the stage for the decisions we face in the future.

Our 25-Year Record—From Surplus to Scarcity

U.S. population has increased almost 40 percent since 1950; agricultural output has more than matched that to supply increased consumption per person as well as increased exports (fig. 1). In spite of these demands for food and fiber and space for living in rural areas, our total land use pattern has remained virtually unchanged (fig. 2). As in 1950, cropland still comprises about a fifth of our total land area, grassland pasture and range about a fourth, forest land about a third, and wasteland an eighth.

The authors are members of the Natural Resource Economics Division, Economic Research Service, U.S. Department of Agriculture. This report is based on their presentation to a meeting of the American Association for the Advancement of Science, New York, N.Y., January 26-31, 1975.

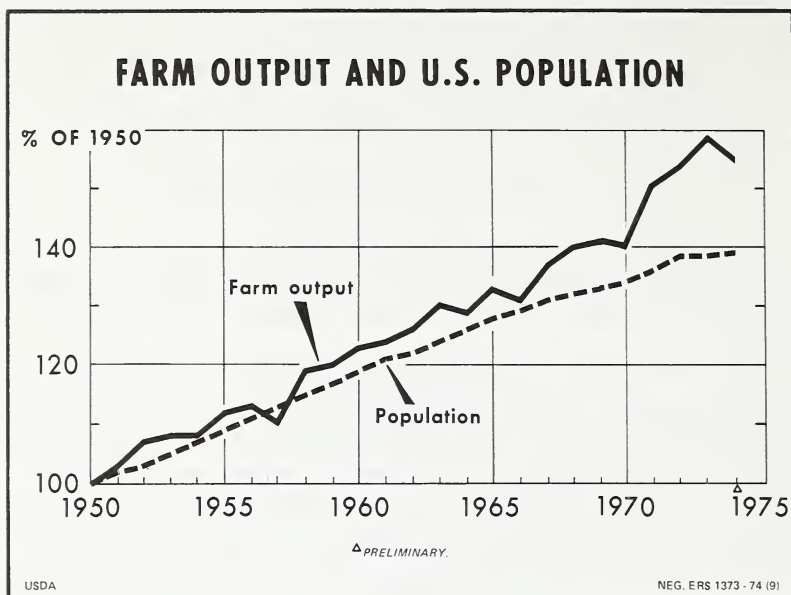


Figure 1

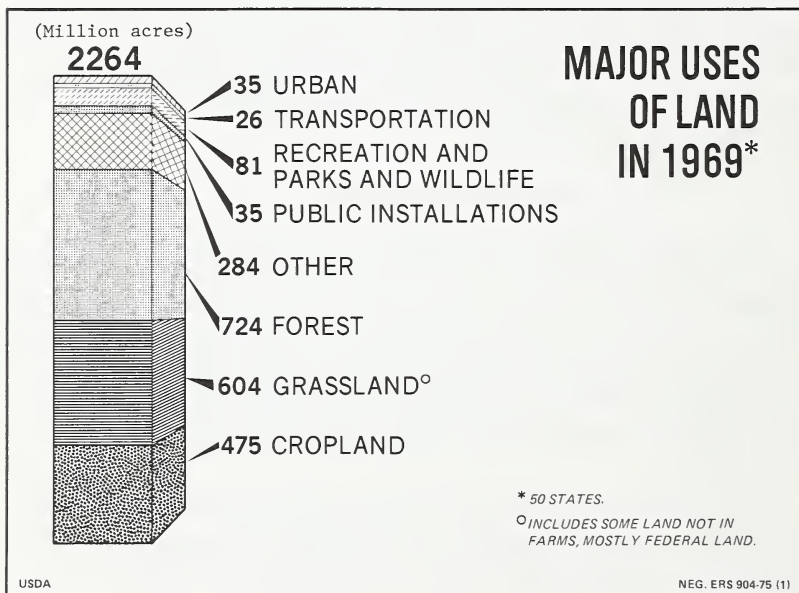


Figure 2

Land for urban use has about doubled since 1950, but still takes only 1-1/2 percent of our 50-State land area. Land for transportation purposes (about 1 percent of the total) is up only slightly because many new roads have been built on existing rights of way. (2)

The bulk of agricultural output comes from the Nation's 475 million acres of cropland. Excluding cropland pasture which fluctuates over time, the base for crop production is about 385 million acres. This acreage has trended downward about a million acres a year over the last several decades because of cropland becoming obsolete in the South and East—for example, hilly, small fields may become incompatible with modern farm machinery.

Until 1972, this 385 million acre base was more than enough to meet food and fiber demand. From 1950 to 1972, total farm output increased 50 percent while productivity per acre advanced 67 percent—an increasing efficiency gained through new or improved technologies including more efficient farm organization, expanded irrigation, and shifts to better land. (16)

The 1950 to 1972 agricultural increases provided 37 percent more people with 9 percent more food per person. Exports accounted for about 20 percent of crop acres harvested up to 1972. Meanwhile, grain stocks were built up to relatively high levels. Wheat stocks equaled about half a year's production and corn stocks a quarter of a year's production.

Not all land classed as cropland was used to produce the additional output. In addition to the increased productivity per acre, substitutes for fats and fibers somewhat lowered cropland needs. Cotton fiber, for example, dropped from 66 down to only 33 percent of total U.S. fiber output. (14)

By 1972, cropland under cultivation amounted to about 50 million acres below the 1950 acreage. During 1961-72, land set-aside or diverted from crop production under Federal programs ranged from 37 to 65 million acres.

Since 1972, however, the picture has changed. Exports have increased 50 percent, consumption per capita is down slightly, and grain stocks are at a minimum.

In 1973, the Federal crop acreage set-aside program was relaxed; farmers cranked 28 million acres back into production. The set-aside program was discontinued altogether in 1974 and farmers reported intentions to plant 17 million more acres, thus using virtually all land identified as cropland. The weather, however, was not cooperative and farmers managed to expand plantings by only 9 million acres. Because of abnormal crop failure, even some of this increase was lost, so that cropland harvested in 1974 was up only 4 million acres from 1973. Because of a 10 percent decrease in productivity per acre, 1974 crop production declined 8 percent from 1973.

Farmers may develop some new cropland in 1975, and more fully utilize the current cropland base. This might provide at least 12 and possibly as many as 16 million additional acres for harvest in 1975. If productivity per acre returns to the 1973 level, 1975 output could jump 14 percent over 1974—10 percent due to higher productivity per acre and 4 percent due

to more acres harvested. This acreage expansion would fully utilize all of the land identified as cropland; additional crop acreage would need to be claimed from other land uses.

Agricultural output in future years will depend on (1) continued increases in per acre productivity, and (2) development of more cropland.

What Are Chances For More Productivity Per Acre?

Farmers boosted total food output by 50 percent since 1950 by substituting machinery, fertilizer, and other inputs for land and labor (fig. 3). Can this trend continue?

With priority energy allotments given to agriculture, increases in productivity are possible. There are several possible alternative sources of nitrogen; supplies of phosphates and potash should be ample. (6) And plant breeders say hybrid varieties of wheat, barley, and soybeans could soon be commercialized. High-protein coarse grain varieties also promise more high-quality food per acre. Nonchemical insect control techniques are being developed, including the breeding of insect-resistant varieties. (6)

Technological change in meat animal production has been slow. Animal scientists, however, anticipate as much as a 20-percent increase in beef production merely through wider adoption of crossbreeding and artificial insemination. Multiple births pose a technological phenomenon for the beef industry similar to the rapid change experienced by the broiler industry in recent decades. (6)

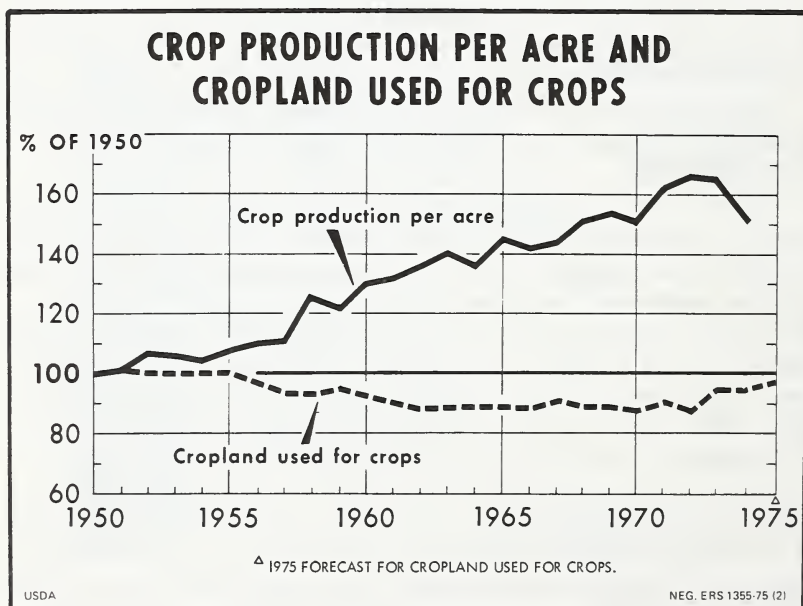


Figure 3

More complete utilization of available forages, particularly in the Eastern States, could spur beef production; farmers now utilize existing pasture and hay resources at only about two-thirds capacity. (4)

Substitution of more vegetable protein for animal protein in the diet would reduce cropland needs significantly. An acre of land in legume crops will produce 10 times the protein for human consumption, compared with an acre in feed grains used to produce protein through beef cattle. (9) At the current price for feed grains, stimulated by worldwide demand, cattlemen have difficulty producing beef at prices consumers are willing to pay. Feed grain prices will probably remain high relative to beef prices, and beef producers may be forced to reduce output. (11)

Beef rations are shifting toward a higher proportion of under-utilized forages and crop residues. As much as 4-6 tons of forage per acre are left after corn harvesting.

In the early 1950's, less than half of our beef cattle were fed out on feed grain concentrates, and only 17 percent of the ration was concentrates—the remainder was forage. By 1970, because of favorable feed grain prices, almost 80 percent of beef cattle were fed out on concentrates and the concentrates portion of the ration had risen to 24 percent. A return to the earlier and lesser proportion of feed grain concentrates in the ration, and growing beef to higher weights before placing them "on feed," would release crop acres for cereal food output. (11)

Increased use of synthetics can ease demand for natural fibers. Artificial sweeteners can replace sugar. Such substitutions could release up to 5 million acres of cropland by 1980. Of course, many of the synthetic and substitute products require raw materials such as petroleum, placing extra demands on nonrenewable resources. (3)

We know little about the impact of cyclical weather patterns on farm production. (5) Some analysts see the significant increase in output levels since 1950 as largely the result of unusually favorable climatic conditions. (13) Unfavorable weather certainly cut 1974's feed grain and oil crop production. Weather modification to change precipitation patterns, reduce hail losses, and minimize storm damage appears possible and may significantly influence productivity in the Western regions.

Because of our increasing concern over environment and health, some production inputs such as DDT, 1080, aldrin, and dieldrin have been discontinued. Withdrawal of each output-increasing or cost-reducing input lowers production unless substitute inputs are used.¹

¹ For discussion of these points, see these ERS reports: Berry, John H., et. al., "Economic Impact of Discontinuing Farm Uses of Aldrin and Dieldrin," Admin. Rpt., 1972; Fox, Austin, et. al., "Restricting the Use of Phenony Herbicides; Costs to Farmers," Agr. Econ. Rpt. No. 194, ERS, 1970; Fox, Austin, et. al., "Restricting the Use of 2,4,5-T; Costs to Domestic Users," Agr. Econ. Rpt.

Another potential constraint on farm output is the price and availability of commercial fertilizer. Like grains, prices of elemental fertilizer nutrients have more than doubled in recent years. For example, anhydrous ammonia averaged less than \$80 per ton for five years prior to 1974; 1974 prices nearly doubled. (18) In the short-run, at least, fertilizer production may not increase as much as the increase in cropland acreage for production, because of limited plant capacity and raw material supplies. (1) (15)

With technology now in the pipeline and with oncoming developments, productivity levels of agricultural land could continue to increase. On the other hand, higher costs of inputs and environmental constraints will undoubtedly slow the growth in productivity. The U.S. Department of Agriculture's current projections indicate that yields will increase but at a dampened rate. At best, productivity per acre is not expected to exceed the rates of increase of the last three decades.

What Are The Chances For More Crop Acres?

Land classified as cropland (excluding cropland pasture) has declined slightly over the last several decades. This, however, is a net change. In some parts of the country, cropland has been abandoned because of economic obsolescence but this acreage was partly offset by reclamation of new and possibly even more productive cropland in other areas (figs. 4 and 5). Consideration of future cropland increases, then, involves the potential for increasing the rate of reclamation or slowing the rate of economic abandonment, depending on the region.

In recent years, new cropland has appeared in a number of well-defined areas at the rate of about 1.3 million acres a year through various techniques including expanded irrigation, drainage, land clearing, reduction in summer fallow, and development of dryland farming. Florida reclaimed land through both drainage and irrigation projects; there was clearing and drainage in the Delta; and, in the Texas High Plains, California, and Washington, irrigation facilities were expanded. Improved dryland farming techniques expanded cropland in Northern Montana and various farm-oriented techniques (drainage, clearing, contouring, and leveling) added to crop acreage throughout the Corn Belt.

In other regions, however, cropland has been abandoned at the rate of about 2.7 million acres a year. Abandonment occurred largely in the States south and east of the Corn Belt except the Delta and Southern Florida.

No. 199, 1971; and Jenkins, Robert B., et. al., "Economic Impact of Discontinuing Farm Use of Chlordane," Agr. Econ. Rpt. No. 231, 1972. Reports relating to livestock include: 'Economic Consequences of Banning the Use of Diethylstilbestrol (DES) in Cattle Feeding,' Admin. Rpt., 1971 and Van Arsdall, Roy N., "Economic Impact of Controlling Surface Water from Point Sources in U.S. Hog Production," Agr. Econ. Rpt. No. 263, 1974.

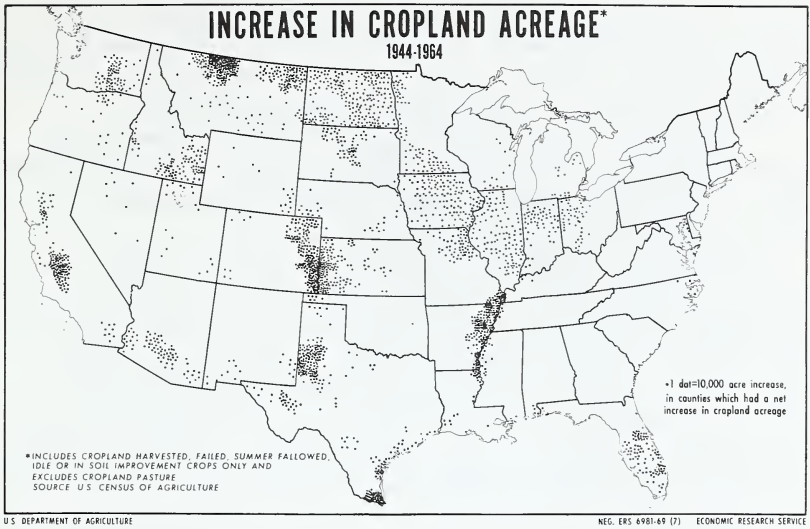


Figure 4

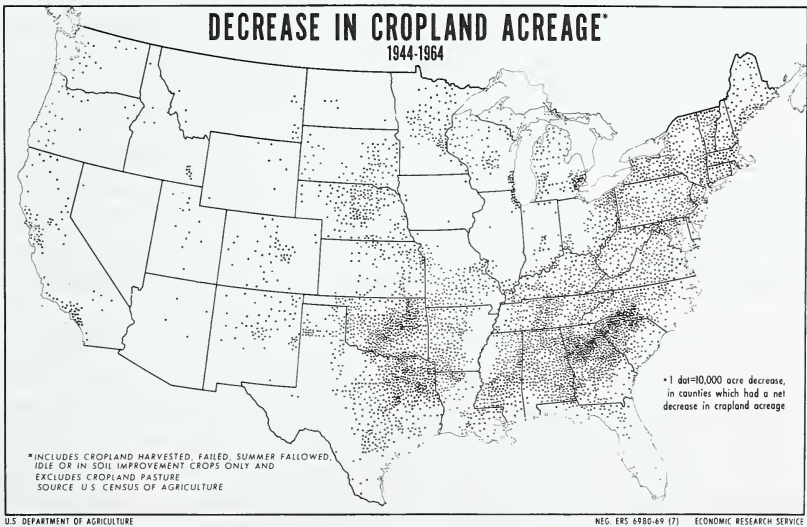


Figure 5

Abandonment east of the Mississippi resulted from low soil fertility and a terrain unsuited to efficient use of modern machinery; many fields are small, rough, and isolated. In large areas of eastern Oklahoma and Texas, cropland reverted to grass which is apparently the best use of land there.

The net effect has been some geographic shift of cropland to areas with more productive soils and/or land better adapted to improved technologies. On balance, this geographic shift in cropland has itself helped to increase the Nation's average cropland productivity. (7)

Much land, not presently being cropped, could be. A USDA survey conducted in 1967 gives a clue of how much more land is suitable for cultivation. This 1967 National Inventory of Soil and Water Conservation Needs (CNI), carried out under the leadership of the Soil Conservation Service, determined the amount of land physically suitable for crop use. (19) The CNI developed data on a county and State basis on the acreages of cropland, pasture and range, forest, and other uses classified by capability of the land for agricultural production. Federal and urban lands were excluded, but little of this land has potential for cropland.

Capability of land was classified according to its agricultural potential and the nature and degree of physical limitation for cultivation and other agricultural uses. The class number (I, II, III, etc.) specifies the degree of limitation. Class I has virtually no limitation for cropping, Class II some limitations, Class III severe limitations, and Class IV very severe limitations. In general, Classes I, II, and III are considered suitable for regular cultivation and Class IV for limited cultivation. Classes V through VIII are generally not suitable for cultivation. Each class is broken down by subclass which specifies the nature of the limitation—erosion, excess water, unfavorable soil conditions, and climatic limitations.

Of the total amount of Class I-III land, 365 million acres (58 percent) were used as cropland and 265 million acres (42 percent) were in other uses (mainly forest and grass) but were considered suitable for regular cultivation.

Class I-III non-cropland is concentrated in the Plains and Eastern regions of the United States (fig. 6). Although there is much potential cropland in the Southeast, there has been no appreciable increase in area actually cropped except in South Florida, where construction of outlet channels has helped drain land (fig. 4). Wetland problems in the Southeast are apparently so widespread, particularly near the coast, that large-scale drainage outlet works, either public or private, are necessary for reclamation.

Again, there is considerable potential in the Northern Lake States, but much of the cropland in that area has been abandoned because the growing season is usually too short for crops other than hay (compare figs. 5 and 6). The large potential acreage in the Appalachia-New England regions is not presently used because fields are generally small and scattered, resulting in high production costs. Much of the potential cropland is in the West, where water is already a limiting factor and/or potential wind erosion is a hazard.

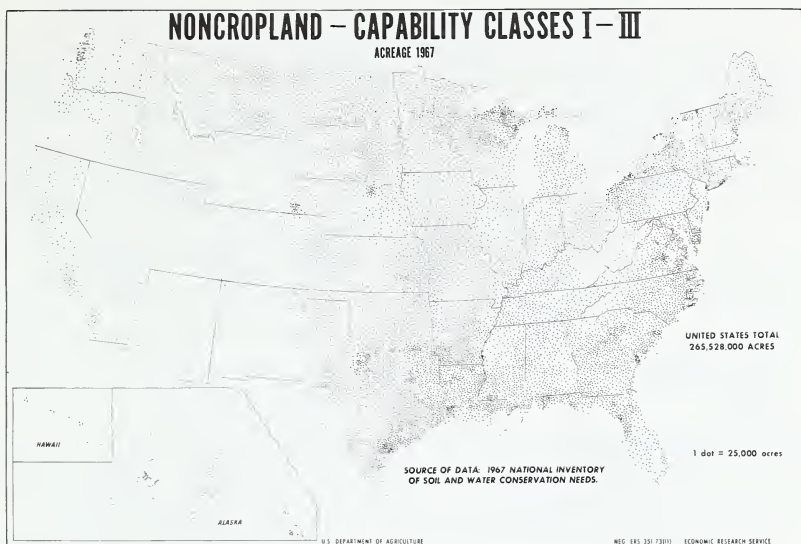


Figure 6

In general, the reasons the Nation's potential cropland is not now in cultivation vary by region but involve the cost of reclamation, cost of operation, or value of product.

Estimates of high, medium, or low conversion-to-cropland potential were obtained by combining the physical capability characteristics provided by the CNI with the regional economic problems and trends as revealed by cropland trend data. We were then able to stratify the 265 million potential cropland acres according to feasibility for reclamation after introducing some economic considerations (table 1).

About 152 million acres have high or medium potential for conversion to cropland. This acreage was further divided into short-run and long-run (short-run acreage could be converted to crop use virtually from one year to the next; the long-run acreage would require construction of works of improvement and thus take a longer period for conversion).

Allocated as low potential are Class I-III land in the (1) Appalachia-Ozark regions, because of small, scattered fields and attendant high cost of operation, which probably explain the high rate of abandonment in these areas; (2) Northeast-Northern Great Lakes regions, because the short growing season in general produces only low-value crops such as hay (also, many of the fields are small and scattered); and (3) Rocky Mountains-Far West regions where water is already a limiting factor (we expect that a good part of it will be diverted from agriculture to energy-generation purposes in

*Table 1. Potential for Conversion to Cropland
(million acres)*

Region	Potential				
	High		Medium		Low
	Short Run	Long Run ¹	Short Run	Long Run ¹	
1. Plains	48.1	4.1	-	-	2.6
2. North Central	15.5	13.8	-	-	7.7
3. Florida	1.1	2.9	-	-	-
4. Miss. Delta-Gulf Coast	3.5	6.7	-	-	.8
5. Coastal Plain-Piedmont	-	-	18.2	19.8	27.3
6. Atlantic Coast Lowlands	-	-	1.3	7.4	.5
7. Texas-Okla. Prairies	-	-	9.7	.6	2.0
8. Appalachian-Ozark ³	-	-	-	-	24.9
9. Northeast-No. Great Lakes ⁴	-	-	-	-	32.4
10. Rocky Mts.-Far West ⁵	-	-	-	-	13.6
Total	68.2	27.5	29.2	27.8	111.8

¹ Drainage necessary.

² Forest and other land with erosion problem.

³ Fields small and scattered.

⁴ Short growing season.

⁵ Water shortage.

the future). In addition, forest land with an erosion problem is allocated as low potential in all other regions. Besides the erosion problem, the land generally has rough terrain as well as high cost of clearing. Also, in all other regions, potential acreage with a wetness (drainage) problem is allocated as medium or high potential, but in the long-run, not in the short-run. This leaves 97.4 million acres with short-run potential—68.2 million with high potential and 29.2 million with medium potential.

The high potential short-run acreage is largely grassland in the Plains that could be readily converted to wheat and grain sorghum production, and pasture land in the Corn Belt and Lower Great Lakes regions. Of the 29.2 million acres characterized as medium potential short-run, the better possibilities are probably in the Texas-Oklahoma prairies, although the Coastal Plain and Piedmont regions have extensive acreages of grassland and woodland that could be brought into production.

Of the 27.5 million acres of high potential long-run and 27.8 million acres of medium potential long-run, the 13.8 million acres in the North Central region needing drainage could probably be developed mainly through individual investment in on-farm drainage works. In other areas, public investment in works to improve drainage for large areas would probably be necessary. In many areas of the Mississippi Delta, much of the basic public investment has already been made and, in fact, part of the potential cropland shown in the 1967 CNI has since been developed.

Of the 265 million acres of land with potential for regular cultivation, about 97.4 million acres are considered to be physically well adapted for conversion to cropland in one to two decades. About half of this acreage is in the Great Plains region. If we assume the 97.4 million acres can be brought into production by 1985, grain sorghum acreage could increase twofold. Cotton and citrus acreage could increase by two-thirds, wheat by more than half, soybeans by one-third, and corn by about 20 percent. Pasture acreage should decrease, possibly by 60 million acres.

This analysis assumes that yields will continue to increase, but at a dampened rate. This scenario is based on the assumption that farmers would use the added cropland for essentially the same crop mix and productivity levels as projected in 1985 for their existing cropland base. It might be possible to increase the cropland base by almost 100 million acres. Our inventory suggests that we have the land resource. The question is—will landowners and managers make the conversion?

High production costs, small farm units, or climatic limitation of areas for higher value cropping alternatives influence the potential for conversion to crop use. Consolidation of land into profitable units depends on the size of tracts and their proximity to existing farmland as well as the plans and preferences of the landowners. Conversion of some of the land would depend on public programs to provide irrigation water and drainage improvement. Much of the land would require special cultural practices to minimize soil and water erosion. In order to bring the land into production, farmers would have to be assured of profit for a number of years in order to offset the investment cost.

Conversion of any of the 265 million acres of cropland would affect the livestock economy as well as the forest economy. Beef production would be constrained because of the conversion of pasture and range to cropland. Some of the shortage of grazing land could be alleviated by changes in the location of beef production, more intensive use of existing roughages, and changes in livestock production patterns, including more cow/calf operations in confinement. Timber production, especially in the Southeast, would be decreased a little by a shift from forest to cropland, but relative to total timber output the effect would be small. Some of the Class I, II and III land not now being cropped is devoted to or has the potential for pulp wood and timber production. Other land use shifts may make it possible to increase forage and timber production.

Our land resource apparently has the capacity to meet future domestic and foreign food and fiber needs. Even with less optimistic yield assumptions the potential is sizeable. However, the continued increase in yields, as well as the actual availability of potential cropland, can and is being questioned. Accordingly, the land resource capacity issue is not entirely clear. The "potential" cropland questions are critical issues as the United States assesses its capacity to meet world food needs. In addition to research on new farm production technology, we need to focus our research on several important areas:

1. *Landownership*—to determine the characteristics and plans for land use, and attitudes of rural landowners;
2. *Land resource competition*—to analyze potential and likely shifts in major land uses among crops, pasture and range, forest, and nonagricultural uses;
3. *Land inventory and productivity*—to identify extent and quality of rural lands for crop and livestock production, as well as other uses;
4. *Prospective effective future demand level for farm products*—to appraise domestic and foreign demand in context of higher costs of production, increased commodity prices, changes in purchasing power, and balance of trade among nations; and
5. *Assessment of farm technology and studies*—to determine feasibility and probable extent of adoption.

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